AMENDMENTS TO THE CLAIMS

This listing of the claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS

1-8. (Cancelled)

9. (Currently Amended) A method of maintaining a desired phase relationship between a generated periodic signal and a periodic reference signal, said method comprising:

generating a first periodic signal with a first delay line and a second periodic signal with a second delay line, each delay line comprising a plurality of unit delays connected in series, the number of unit delays involved in said generating being selectable by digital signals, the difference between said selected number of unit delays in said first delay line and in said second delay line being at least one unit delay;

phase mixing said first and said second generated periodic signals according to an adjustable phase mixing ratio to produce a phase-mixed signal;

measuring a phase difference between said periodic reference signal and said phase-mixed signal after a plurality of cycles of said phase-mixed signal;

adjusting if necessary at least one of said phase mixing ratio and said number of unit delays in at least one of said first and said second delay lines based on said phase difference and said desired phase relationship; and

generating said first and second periodic signals after said adjusting.

10. (Original) The method of claim 9 wherein said adjusting further comprises maintaining said selected number of unit delays in each of said first and said second delay lines while the magnitude of said measured phase difference is less than a certain value.

11. (Original) The method of claim 9 wherein said adjusting further comprises maintaining said phase mixing ratio when said selected number of unit delays in each of said first and said second delay lines are adjusted.

12. (Original) The method of claim 9 wherein said adjusting further comprises resetting said phase mixing ratio when said selected number of unit delays in each of said first and said second delay lines are adjusted.

13. (Original) The method of claim 9 wherein said adjusting further comprises maintaining said selected number of unit delays in each of said first and said second delay lines when said phase mixing ratio is adjusted.

14. (Original) The method of claim 9 the wherein said adjusting further comprises adjusting said selected number of unit delays in each of said first and said second delay line by the same number of said unit delays.

15. (Original) The method of claim 9 wherein said adjusting further comprises maintaining said phase mixing ratio while the magnitude of said measured phase difference is greater than a certain value.

16. (Original) The method of claim 15 wherein said certain value is equal to the delay time of one of said unit delays.

17. (Original) The method of claim 9 wherein said adjusting further comprises maintaining said phase mixing ratio while the magnitude of said measured phase difference is less than a certain value.

18. (Original) The method of claim 9 wherein said adjusting further comprises adjusting said selected number of unit delays in at least one of said first and said second delay lines when said phase mixing ratio cannot be further adjusted.

19. (Currently Amended) The method of claim 9 further comprising:

phase mixing said first and said second generated periodic signals according to a second adjustable phase mixing ratio to produce a second phase-mixed signal; and

phase mixing said phase-mixed signal with said second phase-mixed signal to produce a third phase-mixed signal; wherein said measuring comprises:

measuring a phase difference between said periodic reference signal and said third phase-mixed signal after a plurality of cycles of said third phase-mixed signal.

20. (Currently Amended) The method of claim 19 wherein said ~~phase-mixing~~ phase mixing ratio and said second phase mixing ratio are equal.

21. (Currently Amended) A method of maintaining a desired phase relationship between a generated periodic signal and a periodic reference signal, said method comprising:

receiving said periodic reference signal;

generating a first periodic signal and a second periodic signal, each having a phase, in response to ~~said~~ receiving said periodic reference signal;

phase mixing said first and said second generated periodic signals according to an adjustable phase mixing ratio to produce a phase-mixed signal;

measuring said phase difference between said received periodic reference signal and said phase-mixed signal after a plurality of cycles of said phase-mixed signal;

adjusting, if necessary, via digital signals said phase mixing ratio in response to said measuring; and

generating said first and second periodic signals after said adjusting.

22. (Currently Amended) A method of maintaining a desired phase relationship between a generated periodic signal and a periodic reference signal, said method comprising:

phase mixing a first and a second periodic signal according to a first adjustable phase mixing ratio to produce a first phase-mixed signal;

phase mixing said first and said second periodic signals according to a second adjustable phase mixing ratio to produce a second phase-mixed signal;

phase mixing said first and said second phase-mixed signals according to a third adjustable phase mixing ratio to produce a third phase-mixed signal;

measuring a phase difference between said periodic reference signal and said third phase-mixed signal

after a plurality of cycles of said third phase-mixed signal; and

adjusting, if necessary, via digital signals at least one of said first phase mixing ratio, said second phase mixing ratio, and said third phase mixing ratio in response to said measuring to maintain said desired phase relationship between said periodic reference signal and said third phase-mixed signal.

23. (Cancelled)

24. (Currently Amended) A digital delay-locked loop circuit comprising:

~~a multiplexer;~~

a first delay line having an input, an output, and a plurality of serially-connected unit delay elements, each said unit delay element selectable to directly receive [[the]] said first delay line input, [[the]] said output of said first delay line being fed-back via a multiplexer to said first delay line input to form a loop, said first delay line loop operative to generate a periodic signal from at least the last serially-connected unit delay ~~line~~ element;

a second delay line having an input, an output, and a plurality of serially-connected unit delay elements, each said unit delay element selectable to directly receive [[the]] said second delay line input, [[the]] said output of said second delay line being fed-back via a multiplexer to said second delay line input to form a loop, said second delay line loop operative to generate a periodic signal from at least the last serially-connected unit delay element;

a phase mixer having a first input operative to receive said generated periodic ~~reference~~ signal of said first

variable delay line, a second input operative to receive said generated periodic ~~reference~~ signal of said second variable delay line, a ~~phase-mixing~~ phase mixing ratio control input, and an output, said phase mixer operative to mix said generated periodic signals of said first and said second delay lines according to a digital phase mixing ratio control signal to generate a phase-mixed signal;

a phase detector having a first input operative to receive a periodic reference signal, a second input operative to receive said generated phase-mixed signal, and an output, said phase detector operative to detect a phase difference between said periodic reference signal and said generated phase-mixed signal; and

control logic having an input operative to receive said output of said phase detector, said control logic operative to issue digital signals selecting one of said unit delay elements of said first delay line and one of said unit delay elements of said second delay line and to issue a digital ~~phase-mixing~~ phase mixing ratio control signal.

25. (Cancelled)

26. (Cancelled)

27. (Currently Amended) Apparatus for maintaining a desired phase relationship between a generated periodic signal and a periodic reference signal, said apparatus comprising:

means for generating a first periodic signal with a first delay line and a second periodic signal with second delay line, each delay line comprising a plurality of unit delays connected in series, the number of unit delays

involved in said generating being selectable via digital signals, the difference between said selected number of unit delays in said first delay line and said second delay line being at least one unit delay;

means for phase mixing said first and said second generated periodic signals according to an adjustable phase mixing ratio to produce a phase-mixed signal;

means for measuring a phase difference between said periodic reference signal and said phase-mixed signal after a plurality of cycles of said phase-mixed signal;

means for adjusting if necessary at least one of said phase mixing ratio and said number of unit delays in at least one of said first and said second delay lines based on said phase difference and said desired phase relationship; and

means for generating said first and second periodic signals after said adjusting.

28. (Original) The apparatus of claim 27 wherein said means for adjusting further comprises means for maintaining said selected number of unit delays in each of said first and said second delay lines while the magnitude of said measured phase difference is less than a certain value.

29. (Original) The apparatus of claim 27 the wherein said means for adjusting further comprises means for adjusting said selected number of unit delays in each of said first and said second delay line by the same number of said unit delays.

30. (Original) The apparatus of claim 27 wherein said means for adjusting further comprises means for

maintaining said phase mixing ratio while the magnitude of said measured phase difference is greater than a certain value.

31. (Original) The apparatus of claim 27 wherein said means for adjusting further comprises means for maintaining said phase mixing ratio while the magnitude of said measured phase difference is less than a certain value.

32. (Original) The apparatus of claim 27 wherein said means for adjusting further comprises means for adjusting said selected number of unit delays in at least one of said first and said second delay lines when said phase mixing ratio cannot be further adjusted.

33. (Currently Amended) The apparatus of claim 27 further comprising:

means for phase mixing said first and said second generated periodic signals according to a second adjustable phase mixing ratio to produce a second phase-mixed signal; and

means for phase mixing said phase-mixed signal with said second phase_mixed signal to produce a third phase_mixed signal; wherein said means for measuring comprises:

means for measuring a phase difference between said periodic reference signal and said third phase_mixed signal after a plurality of cycles of said third phase_mixed signal.

34. (Currently Amended) The apparatus of claim 33 wherein said ~~phase-mixing~~ phase mixing ratio and said second phase mixing ratio are equal.

35. (Currently Amended) Apparatus for maintaining a desired phase relationship between a generated periodic signal and a periodic reference signal, said apparatus comprising:

means for phase mixing a first and a second periodic signal according to a first adjustable phase mixing ratio to produce a first phase-mixed signal;

means for phase mixing said first and said second periodic signals according to a second adjustable phase mixing ratio to produce a second phase-mixed signal;

means for phase mixing said first and said second phase-mixed signals according to a third adjustable phase mixing ratio to produce a third phase-mixed signal;

means for measuring said phase difference between said periodic reference signal and said third phase-mixed signal after a plurality of cycles of said third phase-mixed signal; and

means for adjusting at least one of said first phase mixing ratio, said second phase mixing ratio, and said third phase mixing ratio in response to said measuring to maintain said desired phase relationship between said periodic reference signal and said third phase-mixed signal.

36. (Currently Amended) A computer system comprising:

a processor;

a memory controller coupled to said processor; and

a plurality of dynamic random access memory (DRAM) chips coupled to said memory controller, at least one of said DRAM chips comprising a delay-locked loop circuit comprising:

~~a multiplexer;~~

a first delay line having an input, an output, and a plurality of serially-connected unit delay elements, each said unit delay element selectable to directly receive [[a]] said first delay line input ~~signal~~, [[the]] said output of said first delay line being fed-back via ~~said~~ a multiplexer to said first delay line input to form a loop, said first delay line loop operative to generate a periodic signal from at least the last ~~one of said plurality of~~ serially-connected unit delay element[[s]];

a second delay line having an input, an output, and a plurality of serially-connected unit delay elements, each said unit delay element selectable to directly receive said second delay line input, said output of said second delay line being fed-back via a multiplexer to said second delay line input to form a loop, said second delay line loop operative to generate a periodic signal from at least the last serially-connected unit delay element;

a phase mixer having a first input operative to receive said generated periodic signal of said first delay line, a second input operative to receive said generated periodic signal of said second delay line, a phase mixing ratio control input, and an output, said phase mixer operative to mix said generated periodic signals of said first and said second delay lines according to a digital phase mixing ratio control signal to generate a phase-mixed signal;

a phase detector having a first input operative to receive a periodic reference signal, a second

input operative to receive said generated ~~periodic~~ phase-mixed signal, and an output, said detector operative to detect a phase difference between said periodic reference signal and said generated ~~periodic~~ phase-mixed signal; and

~~delay~~ control logic having an ~~output and an input, said~~ input operative to receive said output of said phase detector ~~output~~, said ~~delay~~ control logic operative to ~~select one of said unit delay elements; and~~ issue digital signals selecting one of said unit delay elements of said first delay line and one of said unit delay elements of said second delay line and to issue a digital phase mixing ratio control signal

~~logic operative to activate said phase detector and said delay control logic and to enable said multiplexer after a plurality of cycles of said generated periodic signal~~.